

UTILIZATION OF WASTE

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CONSTRUCTION CERAMIC BASED ON LOCAL ARGILLACEOUS ROCKS AND ALUMINUM CARBONATE-CONTAINING WASTES FROM PRODUCTION OF ISOPROPYLENE

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The physicochemical and process properties of oversanded argillaceous raw materials and technogenic wastes from production of propylene were investigated. The process parameters of production of construction ceramics based on them are reported.

The problem of providing the population with quality and moderately priced housing has now arisen. Without an important increase in production volumes and expansion of the assortment of energy-efficient ceramic construction materials, it will be impossible to solve this problem. Increasing production volumes for such materials is unconditionally correlated with a search for new kinds of raw materials. We investigated the possibility of using previously unclaimed aluminum-containing chemical plant wastes and universally distributed local oversanded argillaceous raw materials.

Weak clays from the Koshchakovo and Petrovsk deposits with a free quartz content of up to 65% were used as the silica raw material for manufacturing the ceramic. This raw material sinters poorly and the samples are insufficiently strong after sintering. For this reason, addition of such an important component as alumina, Al_2O_3 , to the ceramic paste should improve these properties as the physicochemical properties of calcined ceramics are essentially a function of the amount of alumina. Using aluminum-containing chemical plant wastes containing CaCO_3 in addition to Al_2O_3 was proposed.

Isopropylene production wastes are a loose grey mass with a volume mass of 0.85 g/cm^3 and the following chemical composition (% in matter calcined at 400°C): 27.7 Al_2O_3 , 11.5 CaO , 2.3 MgO , 48.9 SiO_2 (including 26.2 crystalline quartz, 22.7 amorphous), 0.3 TiO_2 , 2.4 Fe_2O_3 , 1.1 ($\text{Na}_2\text{O} + \text{K}_2\text{O}$), 0.7 SO_3 , 5.1 calcination loss. In roasting a rationally selected mixture of silica argillaceous raw material and alu-

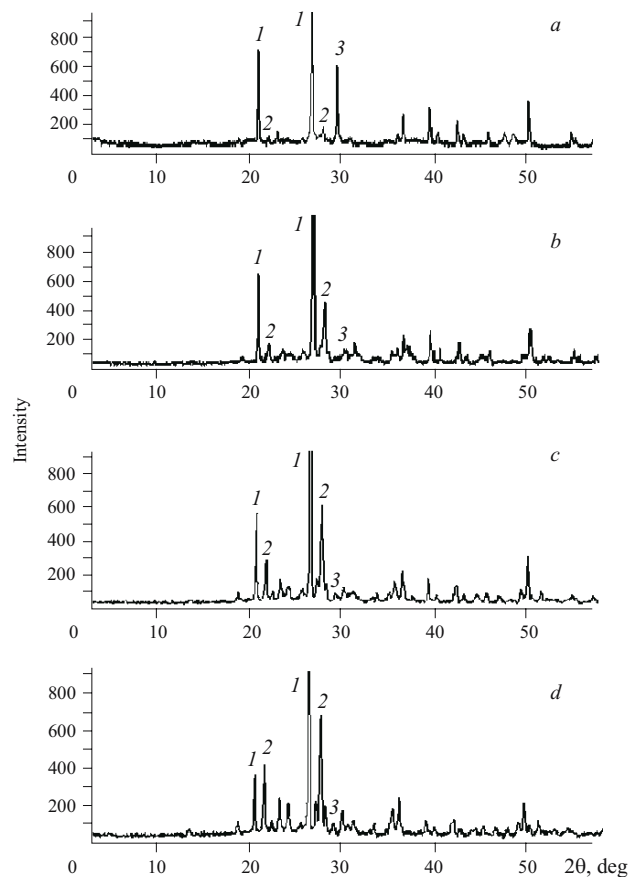


Fig. 1. X-ray patterns of samples: a) unroasted; b, c, and d) after roasting at 1100, 1150, and 1200°C ; 1) quartz; 2) quartz plagioclase (anorthite); 3) calcite.

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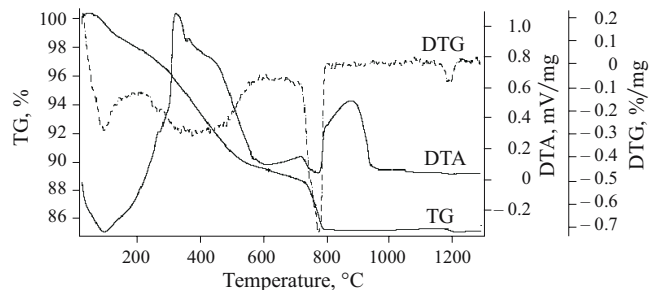


Fig. 2. Derivatograms of ceramic paste.

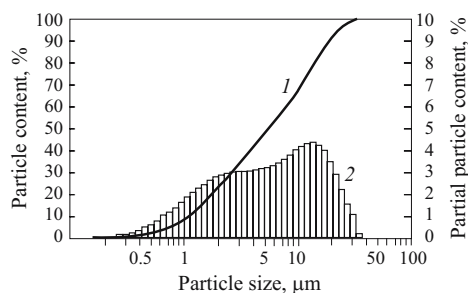
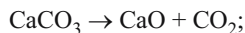


Fig. 3. Granulometric composition of mechanically activated ceramic paste: 1 and 2) total and partial particle content.

minum-containing wastes, the following phase transitions are observed:

calcium carbonate decomposes at 950 – 1000°C:



the CaO formed forms calcium plagioclase $\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ (anorthite) at 1000 – 1050°C in reacting with the other components of the ceramic paste – Al_2O_3 and

SiO_2 ; when the temperature is raised, the intensity of its formation increases.

Anorthite is characterized by the lowest CaO : SiO_2 ratio of all known calcium compounds with a body lattice. This is one factor in its high chemical stability and mechanical strength which makes it possible to use it as a crystalline binder in ceramic materials (Figs. 1 and 2).

Quartz crystals behave inertly during roasting at temperatures below 1200°C. For this reason, mechanical activation of both argillaceous sands and wastes was used in preparing the ceramic paste. Mechanical activation consisted of grinding these components in a vibrating mill to a particle size of less than 0.05 mm (Fig. 3). This resulted in partial amorphization of the quartz crystals, which favored their subsequent melting and intensive formation of glass phase at 1100°C. Fine grinding also activated formation of calcium plagioclase in roasting.

At the same time, the unstable compounds $2\text{CaO} \cdot \text{SiO}_2$ (belite), $3\text{CaO} \cdot \text{SiO}_2$ (alite), or $2\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{SiO}_2$ (hele-nite) can form in zones of excess CaO content, so that it is necessary to accurately calculate the amount of calcium-containing component added and to uniformly distribute it.

Feldspars are added to ceramic pastes for formation of a glassy phase which acts in three different ways. First, it dissolves other constituent parts of the paste; second, it gives the material pyroplasticity and strength in roasting, making it capable of counteracting the deforming forces from the mass of the roasted article to some degree; third, it favors crystallization of new crystalline phases from the melt (mullite in particular).

By using siliceous raw materials and aluminum-containing chemical plant wastes, it is thus possible to organize production of ceramic materials with high physicomachanical characteristics, including clinker articles.